CETP Bangladesh Biological System Restoration with MICROBE-LIFT® Remediation

Location: **Dhaka**

Background: This **CETP** is an industrial wastewater treatment plant in Dhaka treating textile industrial wastewater with a current daily flow rate of 24,000 m^3, with a more significant variation between day and night. The WWTP commenced operation in Feb 2012. The current design is based on two aerated biological treatment systems with about 10 hours HRT with two rectangular clarifiers in series. This is followed by six sets of **ECR** (Electro Contaminant Remover), each 250 m^3 per hr/65% COD remover rate, averaging four machines in operation most of the time. Eight rectangular clarifiers follow this to extract sludge using polyacrylamide polymer. The effluent after **ECR** is further treated at three aeration tanks, 15A, 8A, and 14B, with a total of 12 hrs HRT, mainly to increase DO for the final effluent.

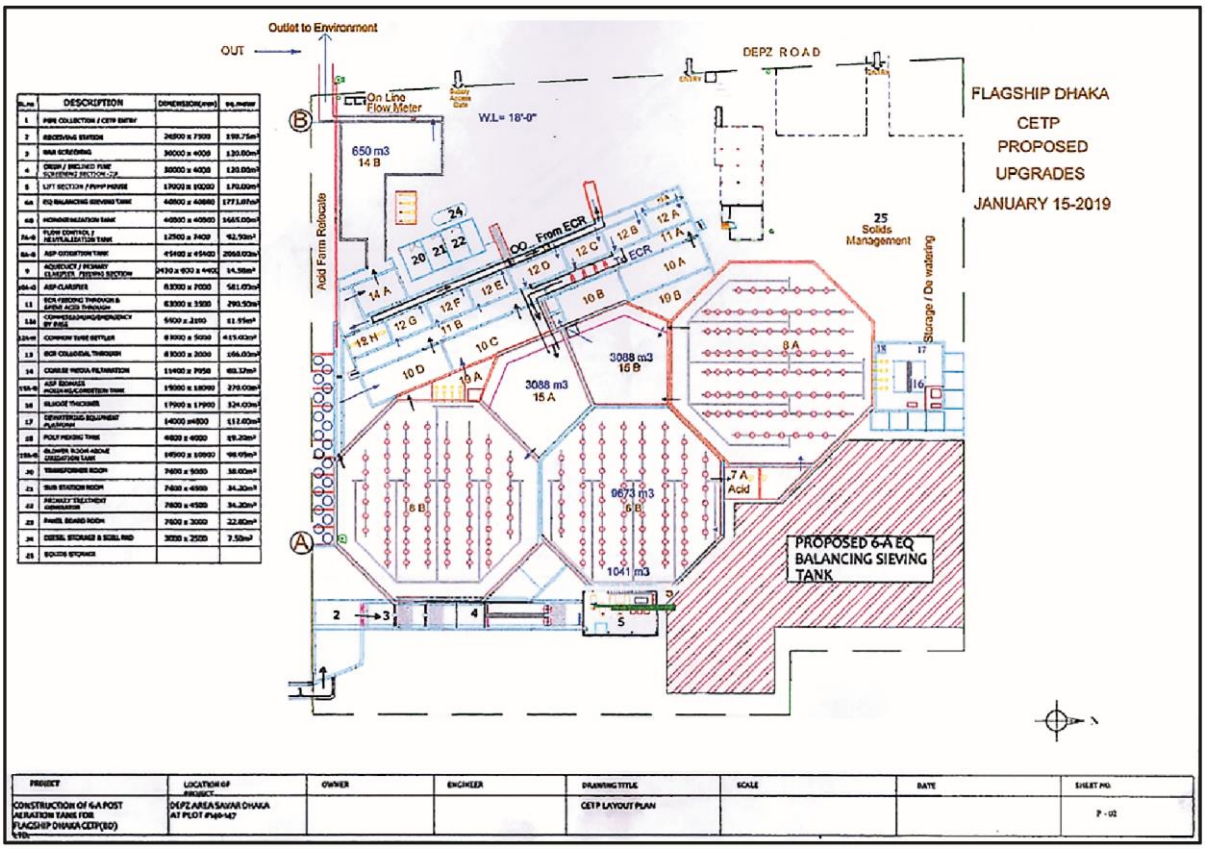

Fig. 1 - *Existing Layout Plan*

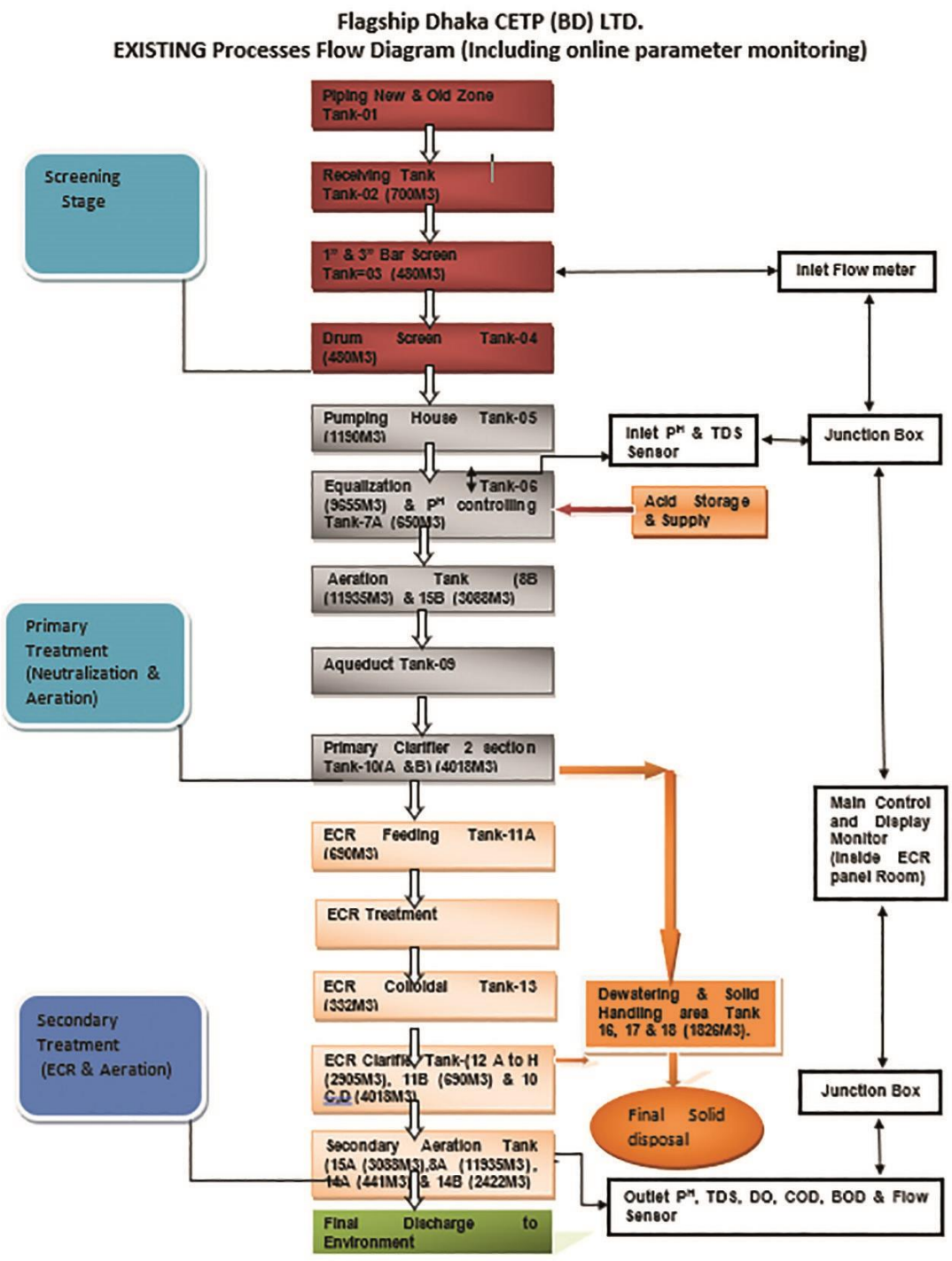

Fig 2: *Existing Schematic Diagram*

The average daily flow rate range's from 22,000 m^3 /day to 27,000 m^3/day, with an average of 24,000 m^3/day. It is also desired to increase the flow rate to 35,000 m^3 per day to meet future treatment capacity.

Influent and effluent water parameters and discharge requirements are as follows:

	INFLUENT	EFFLUENT	STANDARD
COD (mg/L)	800 -1000	100 - 150	<200
TDS (mg/L)	1700 - 2700	1700 - 2700	<2100
pH	10 -11.5	8 - 8.2	6 - 9
TSS (mg/L)	300 - 430	40 -120	<150
BOD	200 - 250	25 - 30	<50
DO	0	6.5	>4.5

There are hardly any biological activities in the biological system. No bio floc is developed in the aeration tank, and the two clarifiers connected in series are only 1/3 the capacity and cannot achieve effective settling. As such, there was no activated return sludge (RAS). Nevertheless, the aeration tank reduced about 200 mg/L COD before **ECR** treatment.

Pilot Scale Evaluation

A 2000L pilot-scale activated sludge return system was set up to test the viability of **MICROBE-LIFT®** in reducing the COD of the influent wastewater at CETP in March 2019. The pilot test demonstrates **MICROBE-LIFT®** can reduce 50% of the COD with a ten-hour HRT.

Modification made from July 2019 to Jan 2020

A new 11,980 m^3 equalization tank was constructed with an additional fine screen filter to remove large solid particles. The existing equalizing tank 6B is converted to the first aeration tank.

The existing clarifier tank 10A and 10B, with a surface area of 287m^2 each, is grossly insufficient for a daily flow rate of 24,000 m^3/day. The biological system had no activated sludge return (RAS) or waste-activated sludge (WAS). As such, there is no MLSS in aeration tanks 8B and 15B. The biological system does not function as such.

An effective clarifier system that can return activated sludge to build up the MLSS at the aeration tanks is crucial for successful biological treatment. Two new clarifiers were initially proposed for the upgrading. The estimated cost of the additional clarifiers is USD 1.2 million. Existing tank 15B, which has a bottom hopper system, is recommended to convert into a third clarifier in addition to clarifiers 10A and 10B. The exact size of the clarifier requirement is complex engineering work and requires a detailed analysis of the type of biofloc settleability characteristics. Without this data, a 1m^3 per hour flow should have a minimum of one sq. m surface area of the clarifier tank—the current maximum flow rate is 1,100 m^3 per hour. Tank 15B has a 540 m^2 surface area, but this tank is not designed as a clarifier so that it can handle at most 400 m^3 per hour flow. Tank 10A and 10B have 287 m^2 surface area each. The effluent will be diverted to clarifiers 15B, 10A, and 10B in parallel operation instead of existing series operation for 10A and 10B with flow rate divided at 40%, 30%, and 30%, respectively.

Submergible pump 9kW 250 m^3/day with variable frequency drive each to be installed at tanks 15B, 10A, and 10B to return activated sludge to tanks 6B and 8B. The volume of sludge to transfer must be monitored manually so that only the sludge portion is returned as RAS. MLSS at tanks 6B and 8B will be maintained at around 2000~2500 mg/L. When MLSS is reached, access RAS to be pumped to sludge press as WAS.

It is crucial to monitor the sludge settleability at the three clarifiers continuously. Should tanks 15B, 10A, and 10B be insufficient to achieve a reasonable settlement, tank 15A may be converted as 4^{th}.

clarifier.

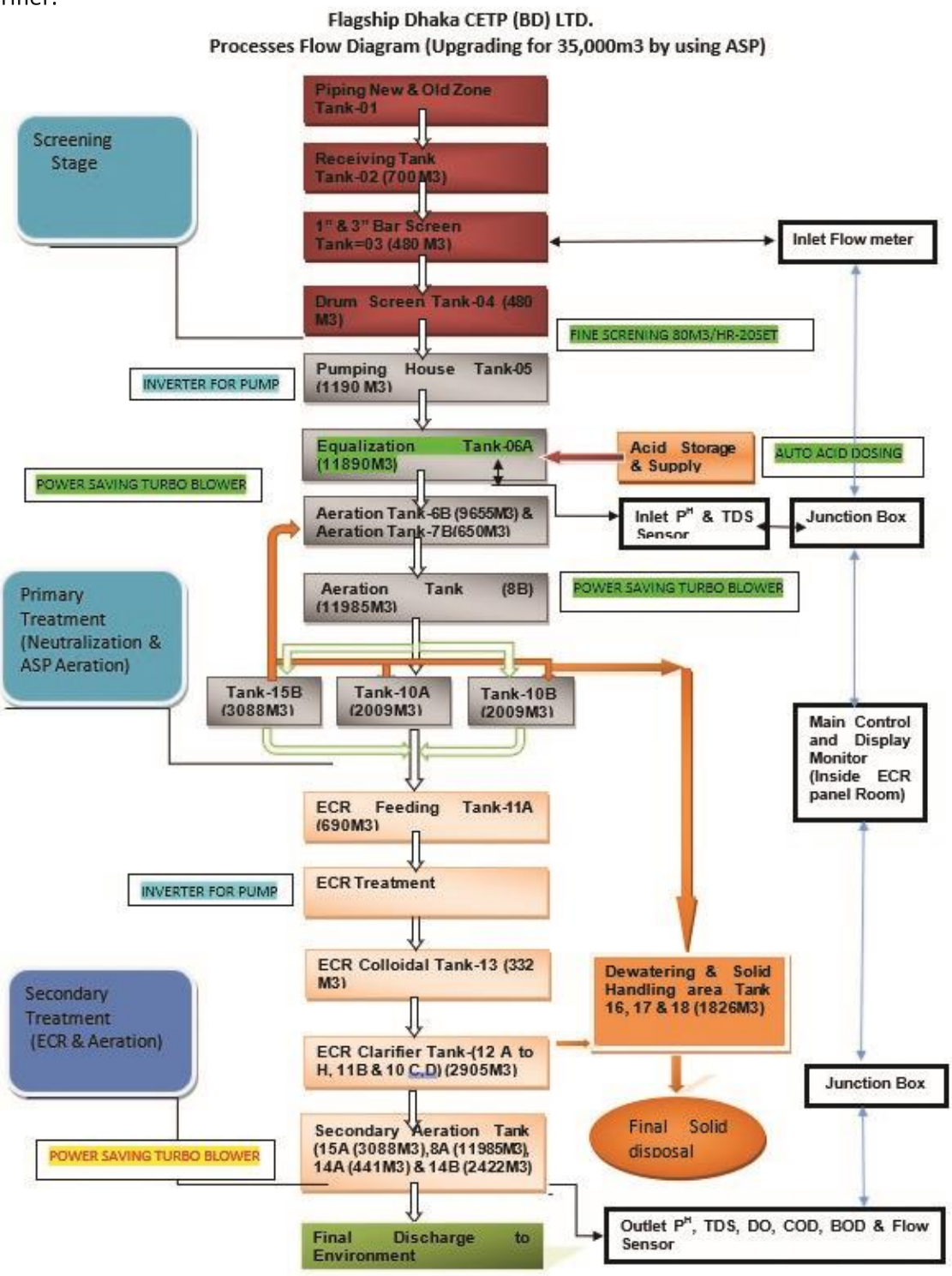

Fig 3: *New Schematic Flow Chart*

Fig. 4: *The New 11,890 m³ Equalization Tank*

Fig. 5: *Aeration Tank 6B and 8B*

Without a proper clarifier, a small amount of HDPE cylindrical type biomedia was introduced to both aeration tanks to ensure at least some bacteria are retained in the aeration tank.

MODEL: PE05

Spec.:	ϕ25*10 mm
Surface area:	>600 m^3/m^3
Density:	0.94 - 0.97 g/cm^3
Packing Numbers:	118000 pcs./m^3
Dosing Ratio:	15% - 65%
Life span:	>15 years
Nitrification efficiency	400 -1200 gNH_4 - $N/m^3.d$
Material:	HDPE

Fig. 6: *Biomedia Specification from China*

Based on the manufacturer's recommendation, 4500 CBM is required for the two aeration tanks, but only 210 CMB was introduced.

Fig. 7: *Pouring of Biomedia to Tank 8B*

MICROBE-LIFT® Bioaugmentation

Based on 24,000 m^3 per day flow rate, **MICROBE-LIFT®/**IND and **MICROBE-LIFT®** /SA dosing recommendation is as follows:-

	MICROBE-LIFT® /IND	**MICROBE-LIFT®**/SA
Day 1 & 2 (From 11th Feb 2020)	40 gallons per day	30 gallons per day
Day 3 to 7	20 gallons per day	15 gallons per day
Day 8 to 30	8 gallons per day	4 gallons per day
Thereafter >30 days	4 gallons per day	2 gallons per day
1st-month usage	340 gallons	215 gallons
Thereafter per month	120 gallons	60 gallons

Dosing will be directly applied at the inlet area of tank 6B and 8B. For the first week's dosing, 50% each at tank 6B and 8B, after that, dosing can be done at tank 6B only.

Fig. 8:* *MICROBE-LIFT®* *Inoculation on Feb 11th 2020

For the biological system to work efficiently, the followings monitoring is critical:

1. Maintain pH at 7 to 8 at all times in the aeration tanks;

2. Maintain DO not less than 1.5 ppm at all times;
3. Regularly check C: N:P ratio to make sure there is nutrient balancing for biological treatment, and prepare DAP and urea available for nutrient addition at any time if necessary;
4. Adjust RAS and WAS and monitored the clarifier function to ensure good settleability and proper maintenance for the desired MLSS at the aeration tanks.

The flow rate was reduced by 50% to 500 m^3 per day for 5 days after inoculation to allow longer HRT in the aeration tank.

The **MICROBE-LIFT®** bio augmented biological system is expected to reduce the COD from 900 mg/L to 350 mg/L. This will reduce the ECR loading by more than 60%.

Performance Analysis one month after inoculation

The biological system managed to reduce COD from 1000 mg/L to about 300 mg/L from its original value of 1000 mg/L to 700 mg/L within one month of **MICROBE-LIFT®** bioaugmentation. The reduced COD before ECR treatment reduces the ECR electricity and steel plate consumption by 60%. The post-ECR sludge was also reduced by half, thereby PAC and sludge disposal costs. Sludge disposal cost is not high, but it is a very messy job that no workers like to handle. The workers are delighted with the reduced sludge handling.

However, due to the low BOD loading, there were insufficient bioflocs to form effective RAS (Return Activated Sludge); hence the aeration tank MLSS remains at only about 400 mg/L. The biomedia helps to retain the bacteria in the aeration tank.

A summary of cost benefits from **MICROBE-LIFT®** Bioaugmentation on essential variable expenses was analyzed and compared to expenses incurred without **MICROBE-LIFT®** Bioaugmentation as follows:

CETP Performance Analysis

Item	Description	Unit	w/o Microbe-Lift	with Microbe-Lift
1	Period		Before Jan 2020	From Feb 2020
2	Average flow rate	m^3/hr	1,000	1,000
	Total water volume treated per day	m_3	24,000	24,000
3	**Electricity used by ECR**			
	Electricity use by ECR per day	kWh	12,000	4,600
	Electricity Cost per kWh	BDT	8.97	8.97
	Average daily electricity cost	BDT	107,640	41,262
	Electricity Cost per m^3 water treated	BDT	4.49	1.72

4	**Steel plate consumption**	kg	2170	1175
	Steel plate per m^3 water treated	kg	0.0904	0.0490
	Cost of steel plate	BDT	72	72
	Cost of steel plate per m^3 water treated	BDT	6.51	3.53

Item	Description	Unit	w/o Microbe-Lift	with Microbe-Lift
	Period		Before Jan 2020	From Feb 2020
5	**Sludge Processing**			
	Sludge disposal cost per day	BDT	8400	4200
	PAC cost per day	BDT	120	60
	Sludge processing cost per m^3 water treated	BDT	0.36	0.18
6	**MICROBE-LIFT®**			
	Long Term **MICROBE-LIFT®** use per day	gal.		7
	Cost of Microbe-Lift per gal	BDT		6000
	The total cost of Microbe-Lift per day	BDT		42000
	Cost of Microbe-Lift per m^3 water treated	BDT		1.75
7	**Urea**			
	Daily Urea Usage	kg		50
	Cost of Urea per kg	BDT		20
	Cost of Urea per m^3 water treated	BDT		0.04
8	**Biomedia cost**	BDT		3,250,000
	Biomedia cost amortized over ten years	BDT		890.41
	Biomedia cost per m^3 water treated	BDT		0.04
9	**Total valuable cost per m^3 treated**	BDT	11.35	7.25
	% on cost saving			36%
	Note: USD 1= BDT 85 at the time of analysis			

By July 2020, the treatment plant is expected to increase the treatment volume to 30,000 m^3 per day. More biomedia will be introduced into the aeration tanks, and we expect the plant can manage the 25% increase in daily flow rate without expanding the aeration system

Since March 2021, the CETP has opted to apply a higher-value microbial consortium, **PRO-PUMP**, to enhance the system's performance and increase its treatment capacity.

For more information on **MICROBE-LIFT®** Technology, contact
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www.EcologicalLabs.com
CS14402